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Facies Associations Review Of Depositional Environments In The External Hellenides Isopic Zones, Ionian Sea And Western Greece Margin

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Background & Methods

The studied area of the Ionian Sea and the Western Greece margin, running from the Diapondia Islands-north of Corfu Island, to Filiatra in Southern Peloponnese, is characterized by the most external Hellenides zones and the Apulian Platform. It is well known that during the Tethyan rifting, taphrogenetic processes divided the uniform carbonate platform into shallower parts (the Apulian Platform, its margin the Pre-Apulian zone, and the Gavrovo-Tripolitza Platform) and deeper parts (the Ionian basin). From that time, different sedimentary evolution processes took place in each part, thus the zones exhibit distinct lithostratigraphic columns with different petroleum systems (Karakitsios, 2013).

The external Hellenides units are separated by NW-SE trending thrusts. In the offshore areas of the Ionian Sea, a system of NE-SW strike-slip faults cross-cuts the Apulian, Pre-Apulian and Ionian units. The most important of these strike-slip faults is the Kefalonia Transform Fault Zone (KTFZ), dividing the offshore area in two (2) segments; the north and the south segments. For the purpose of this study, eight (8) wells have been selected in order to cover both geographically the three segments and stratigraphically the external Hellenides zones which are present in the area. In the north segment: East Ericoussa-1, Yanadhes-1, Paxos Gaios-1X, and Parga-1; and in the south segment: South Kefallinia-1, Agios Kirikos-1, Sosti-1 and Peristeri-1.

A hierarchical approach to sedimentological description and interpretation has been applied to generate the present lithotypes/lithofacies (LTs/LFs) through cuttings and core data. The LTs/LFs have been grouped in bed-set scale units-depositional packages (DPs) with similar characteristics and internal organization. The vertical and lateral organization of the depositional packages can define the bed-set stack scale facies associations (FAs) with specific geometries and dimensions. These facies can be assigned to specific depositional environments.

Results & Conclusions

The wells which have been drilled on the Ionian zone, exhibit a wide range of both clastic and carbonate depositional environments, ranging from shallow marine, coastal, deltaic, to deep-water (Table 1). On the other hand, the wells which have been drilled on the Pre-Apulian unit, exhibit shallow marine carbonate deposits overlaid by deep-water to shallow-marine clastic sediments. Consequently, the aforementioned depositional environments have their distinct FAs and DPs in different proportions through geological time.

The differences between north Segment and south Segment might be due to:

- Different isopic domains (Jurassic, Ionian → deep Vs Pre-Apulian → shallow)
- Rifting and paleogeography (Cretaceous to Eocene, development of new platforms in the area)
- Shallowing (Oligocene-Miocene, relatively shallowing of northern Ionian domain, compared to the southern)
- Coverage and well position issues (Oligocene-Miocene, higher coverage from well data in north segment)
- KTZ juxtapose of FAs (Pliocene – Pleistocene, juxtaposition of deeper FAs of south segment westwards compared to northern segment)

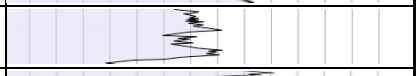
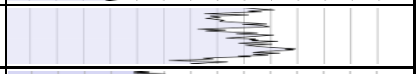
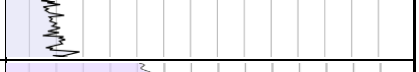
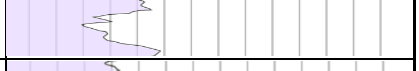
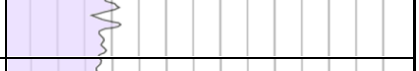
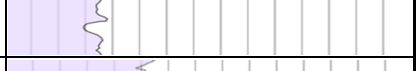
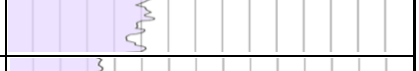
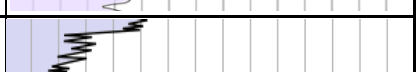
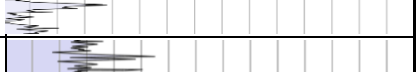
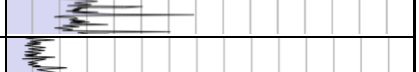
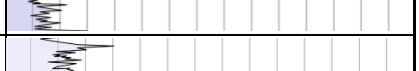
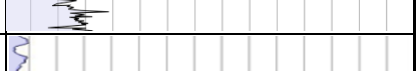
The depositional environments interpretation of this study, confirms the onshore data studies (Karakitsios et al, 2010b; Makrodimitras, 2011; Maravelis et al, 2014).

The available log data can give a first impression of the FAs with the best reservoir properties, such as the upper shoreface, proximal lower shoreface, channel, lobe and shallow shelf deposits. However, the hydrocarbon shows during the drilling program, might range and be present in a wide range of FAs (asterisk * in Table 1).

This model confirms previous studies in western Greece areas (Getsos et al., 2007), where Pre-Apulian Zone deposits were assigned to inner carbonate ramp, and external to middle Ionian Zone assigned to middle to outer carbonate ramp conditions. The well data which correspond to inner ramp conditions are the evaporitic, sabkha, lagoonal and tidal flat deposits of Paxos Gaios-1X and South Kefalinia-1. The middle to outer ramp conditions represented by the slope and base of slope deposits, were observed mostly in South Kefalinia-1.

The tectonism of the External Hellenides, which is moving to the SW, along with the presence of the major strike slip faults, leads to a juxtaposition of depositions from different geological environments, making them present quite far from the place initially deposited and even further from the source of sedimentation regarding the clastic sediments. Due to the structural setting of the area and the distance between the wells, any attempt to correlate specific FAs among wells is very speculative, leading us to correlate only coeval deposits in terms of age.

Table 1. Facies Association log signature in selected wells from Western Greece. Asterisk (*) on hydrocarbon shows.

Depositional system	Facies Associations	GR log characteristic	GR Log curve
Coastal Plain	Floodplain channel	Moderate to low amplitude due to sandstone presence. Abrupt high spikes due to mudstone.	
	Floodplain valley*	High to very high amplitude (60-150 GAPI). Profile range from funnel to irregular blocky shape	
	Swamp*	High amplitudes due to mudstone. Sandstone and lignite contribute to typical irregular shape.	
	Bay/Lagoon*	Very high amplitude (80-100 GAPI) with serrated shape due to mudstone.	
Delta Plain	Prodelta	High amplitude (50-60 GAPI) with serrated shape due to mudstone. Rare higher/lower peaks	
Shallow marine	Upper Shoreface*	Low amplitude (30-40 GAPI) due to sandstone domination, rarely serrated shape	
	Lower Shoreface proximal*	Typically, low amplitude (40 GAPI) for sandstones and higher for mudstone layers	
	Lower Shoreface distal*	High amplitude (40-60 GAPI) due to mudstone domination, and "U" shaped profile for sandstone	
	Offshore Transition Zone*	Typically, high values (50-55 GAPI) with homogenous profile	
	Debritic Sheets	Moderate to low amplitude with "U" shape. When siltstone is present, higher amplitudes	
Deepwater	Basin/Offshore*	Low to very low (5-20 GAPI), homogenous to serrated amplitude.	
	Channel-fill*	Moderate (20-50 GAPI) Blocky "U" shaped to locally upward-dirtying responses.	
	Lobe sandsheet	Clear sandstone responses with blocky to serrated profile (~40GAPI).	
	Lobe sandsheet fringe	Moderate (30-40 GAPI) upward-dirtying responses, or "U" shape among higher amplitude.	
	Inter-lobe mudrock sheets*	High (50-60 GAPI) homogenous to serrated trendless amplitude.	
	Calcareous gravity mass deposit	Low (5-10 GAPI), "U" shape amplitude, easily distinguished among higher amplitude.	
Carbonate Platform / ramp	Evaporites	Moderate to low amplitude with box shape. Profile might be homogenously low when evaporites becomes thick.	
	Sabkha	Irregular shape ranging from "U" shape (due to evaporite precipitation?) to serrated.	
	Lagoon*	Irregular to serrated shape with moderate to low amplitude. Rare spikes due to clay material.	
	Tidal Flat*	Very low amplitude (5-15 GAPI) with minor spikes above 20 GAPI	
	Slope*	Moderate to low amplitude (20-30 GAPI) with spikes up to 40 GAPI. Serrated shape.	
	Base of Slope*	Very low amplitude (5-15 GAPI) with minor spikes above 15 GAPI	

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